

# Training Course / Nucleonica Overview

Dr. Joseph Magill,  
Nucleonica GmbH,  
Karlsruhe

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 ... web driven nuclear science

Saturday, June 30, 2012

Home

username  Login

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Nucleonica [blog]

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Forum

Karlsruhe Nuclide Chart

..... Online Shop

Educational Resources

Training Courses

Ask an Expert

FAQ

About Us

Contact

Impressum

**NUCLEONICA HOT TOPICS**

**» New! Virtual Cloud Chamber**

November 10, 2011

We announce the release of a new Nucleonica module: the Virtual Cloud Chamber. This powerful application is an online interactive simulation tool for investigating the



**What is Nucleonica?**

- » Nucleonica is an innovative professional and technical resource for knowledge creation and competence building for the worldwide nuclear science community. The portal has grown to become the leading online resource in the nuclear sciences and is particularly suitable for education and training of young scientists, engineers and technicians in the nuclear domain. Our applications enable researchers and specialists to make complex and precise calculations in state-of-the-art fashion.
- » Nucleonica is aimed at scientists, engineers and technical personnel working in the fields of nuclear power, health physics, radiation protection, nuclear and radiochemistry, decommissioning, nuclear medicine, etc. It can be used by professionals for everyday calculations, obtaining quick results and testing, validating and verifying complex computer models.
- » Nucleonica provides you with user-friendly access to the latest reference data from internationally evaluated nuclear data. A unique feature is the wide range of web-based nuclear science applications. A variety of social networking tools are provided for scientific collaboration. In addition, Nucleonica offers a range of

**NUCLEAR NEWS**

**New telescope to guard Earth from killer asteroids**  
**JUN 30** Some 500,000 asteroids are circulating near-Earth space and some of them may pose a real danger to our planet. But a US company says it plans to build a telescope that will be able to watch them. [Read \[...\]](#)

**U.N. publishes report on Iran arms trade with Syria**  
**JUN 30** UNITED NATIONS (Reuters) - A U.N. Security Council committee has published a report on Iranian sanctions violations, including shipments of weapons to Syria in breach of a U.N. ban on weapons exports [...]

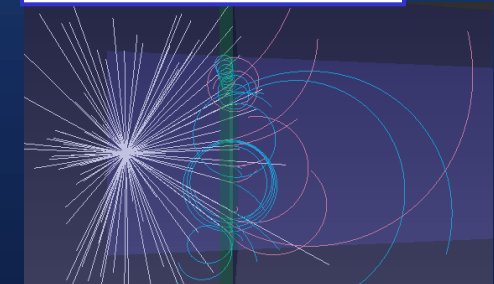
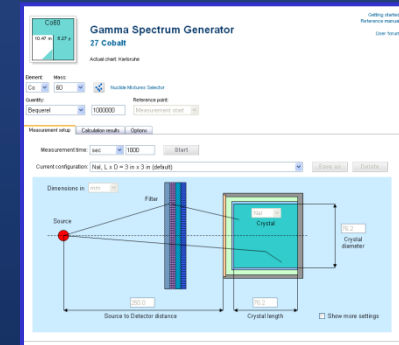
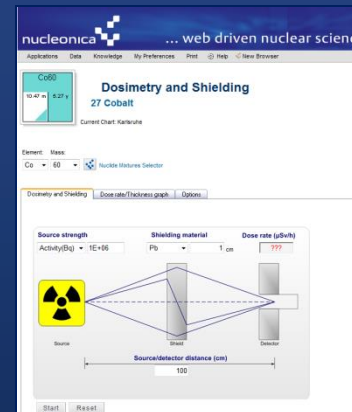
**More firms in danger of systems meltdown, claims risk expert**  
**JUN 30** MORE than half of Irish companies are now at risk of an Ulster Bank-style systems meltdown because they are operating increasingly complicated IT systems -- but have failed to commit to the additional [...]

**Japan discovers large rare earth deposits**  
**JUN 30** Large and rich rare earth deposits, equaling at least 220 times the country's annual consumption, have been discovered near Minami-Torishima island in the Ogasawara Islands, a research

# Nucleonica: Web-based Software Tools for Simulation and Analysis

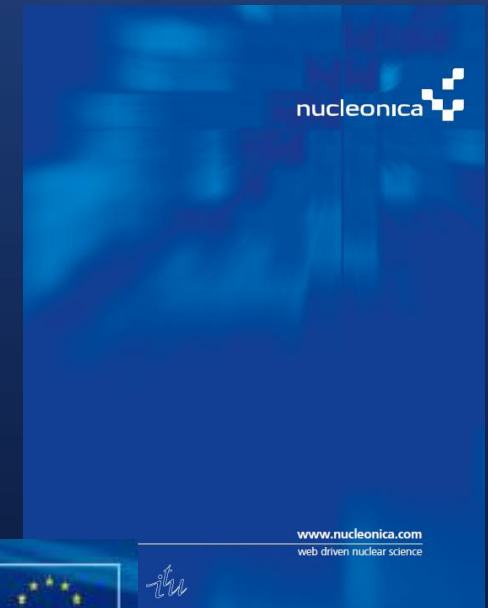


- Nuclear Data Resources in Nucleonica
- Nuclear Science Applications & Tools
  - Decay Engine
  - Dosimetry & Shielding
  - Virtual Cloud Chamber
  - Gamma Spectrum Generator
  - webKORIGEN
  - e-Ship
- Education & Training with Nucleonica
  - Post Grad. Research
  - Nucleonica Mobile
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica



# How can Nucleonica help you?

- Nucleonica provides you with user friendly access to the latest reference data from internationally evaluated nuclear data.
- A unique feature is the wide range of validated web-based nuclear science applications for decay calculations, dosimetry & shielding, gamma spectrometry, etc.
- In addition Nucleonica offers a range of introductory and advanced training courses in various areas of nuclear science.

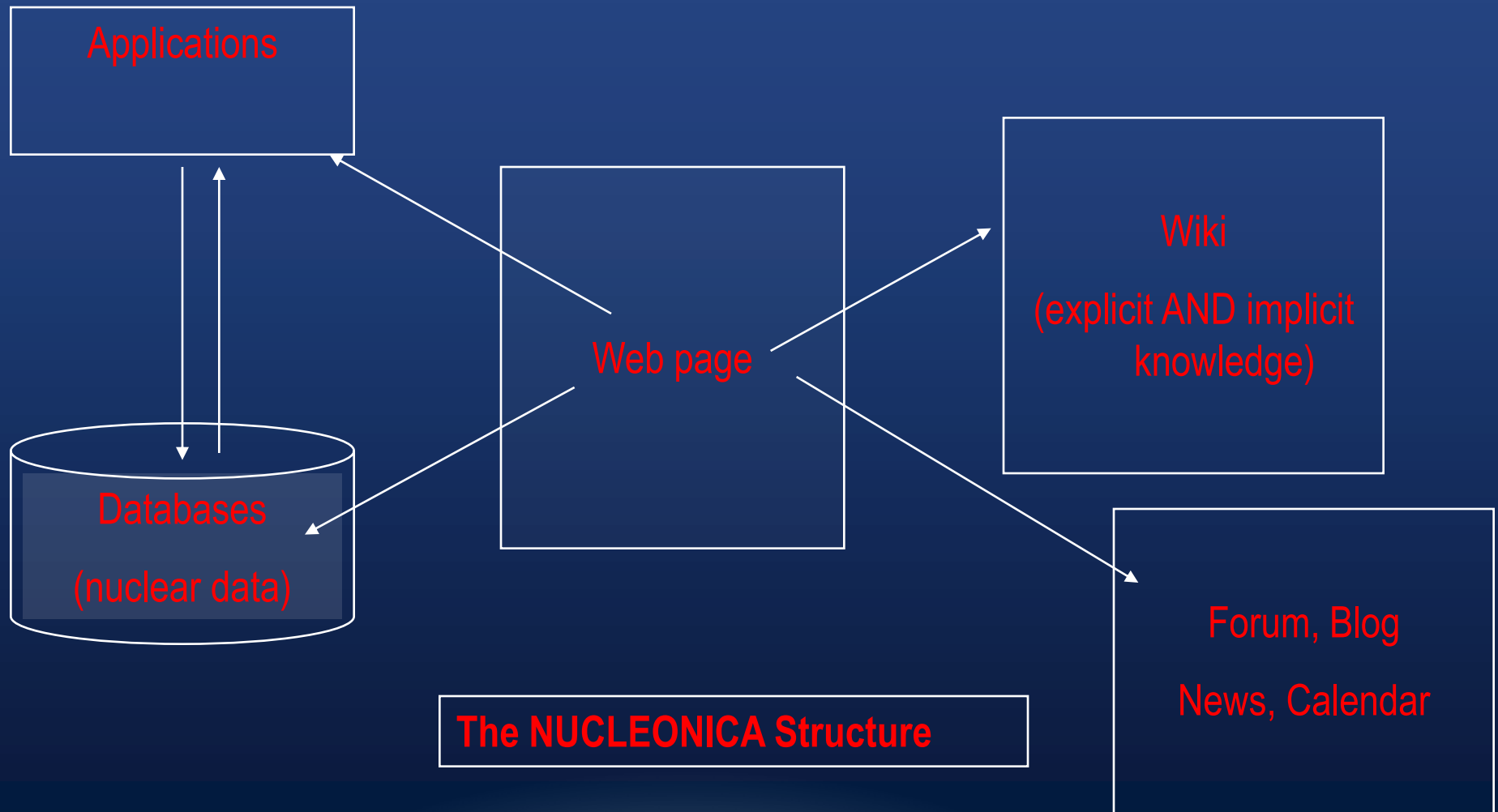


Nucleonica is already being used by thousands of scientists and students worldwide in over 92 countries. Due to its advanced IT features, user friendly and intuitive environment, the platform has recently been endorsed by the Sustainable Nuclear Energy Technology Platform ([www.snetp.eu](http://www.snetp.eu)):



*“Nucleonica plays ... an important role in making nuclear education more attractive and in building nuclear knowledge for a new generation of engineers and scientists”*

# Nucleonica Architecture & Logical Structure...





# Nuclear Data Resources in Nucleonica: Nuclide Datasheets

nucleonica ... web driven nuclear science

Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser

Version: 2012.02.29 19:01:09

**Nuclide Datasheets**  
27 Cobalt

Current Chart: Standard

Element: Co Mass: 60

Coming soon ENDF/B-VII.1

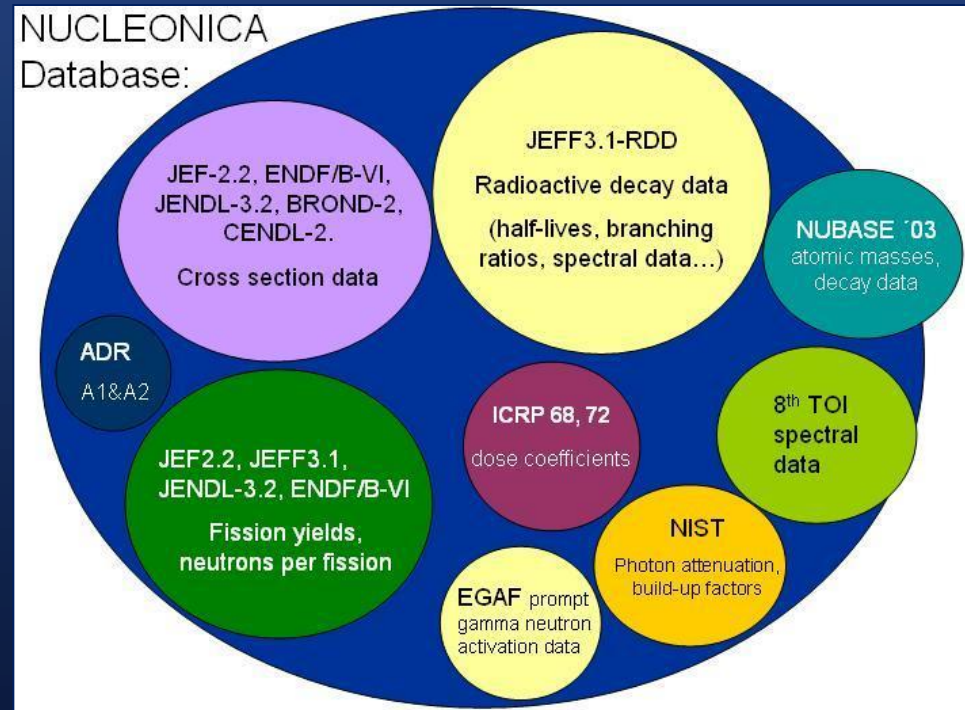
Reference Data Description Derived Data Cross Sections Radiations Prompt Gammas Select Print Outputs

> Reference Data Notes

Nuclide	60 27 Co 33		
Density	8.86 g/cm <sup>3</sup>		
Mass Excess	-61649.012 (± 628) keV		
Atomic Mass	59.933817059 (± 674) u		
Half-life	5.271 (± 1) y		
Spin	5 h		
Parity	+		
Binding Energy	8.74675 MeV/nucleon		
Abundance	-		
Effective Dose Coefficient Inhalation	3.1E-08 (Sv/Bq)		
Effective Dose Coefficient Ingestion	3.4E-09 (Sv/Bq)		
Mean Decay Energies			
Alpha	0 (MeV)		
Electron	96.7734 (keV)		
Photon	2503.84 (keV)		
Type of decay	Branching Ratio	Decay Energy,Q	Daughters
β-	1	2.8239 (MeV)	28 Ni 60
Type of parent decay	Branching Ratio	Decay Energy,Q	Parents
IT	0.9975	0.0586 (MeV)	27 Co 60m

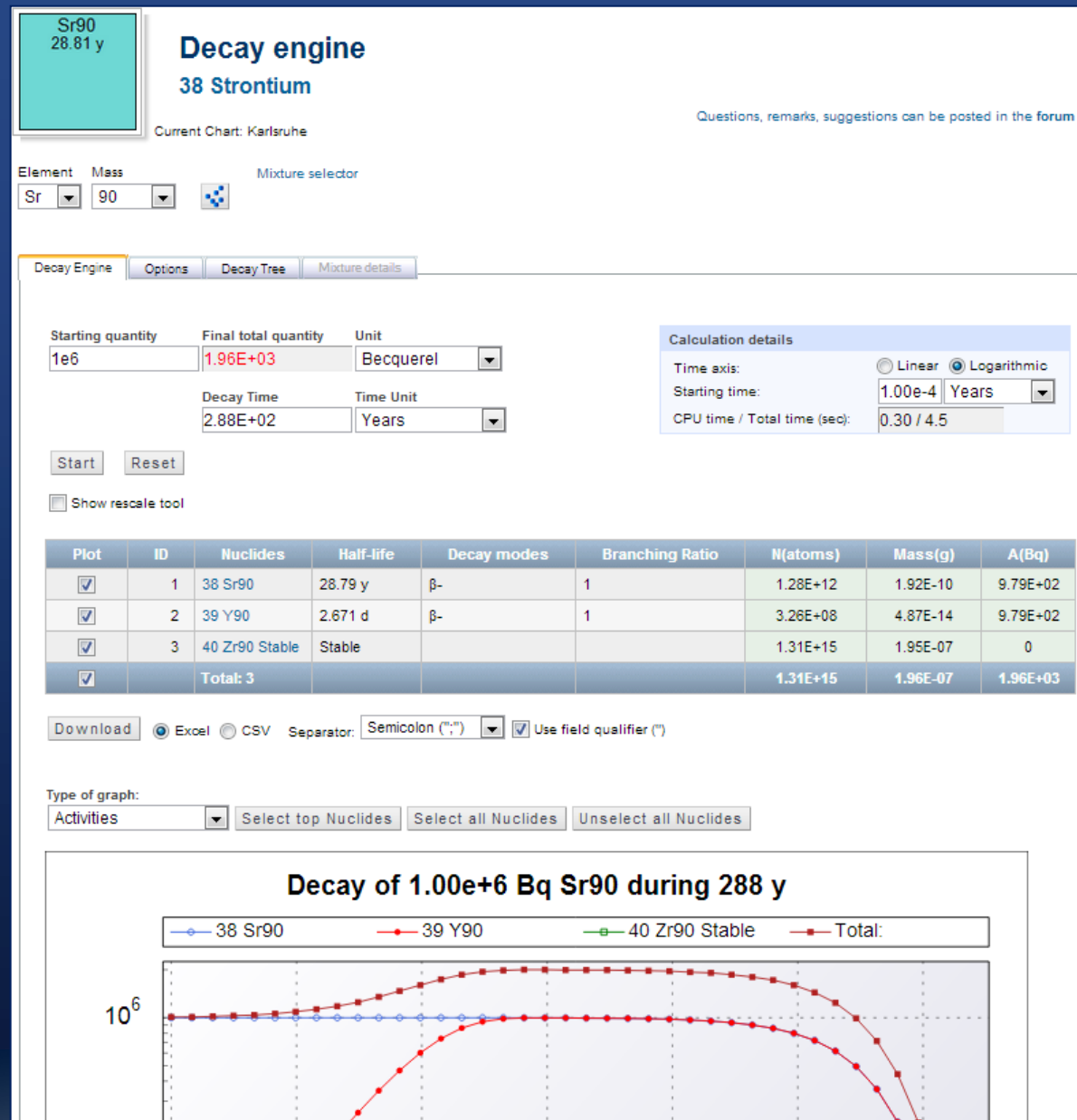
Download Excel CSV Separator: Semicolon (;) Use field qualifier (\*)

Main Nucleonica database JEFF3.1 contains decay data on 3852 nuclide.



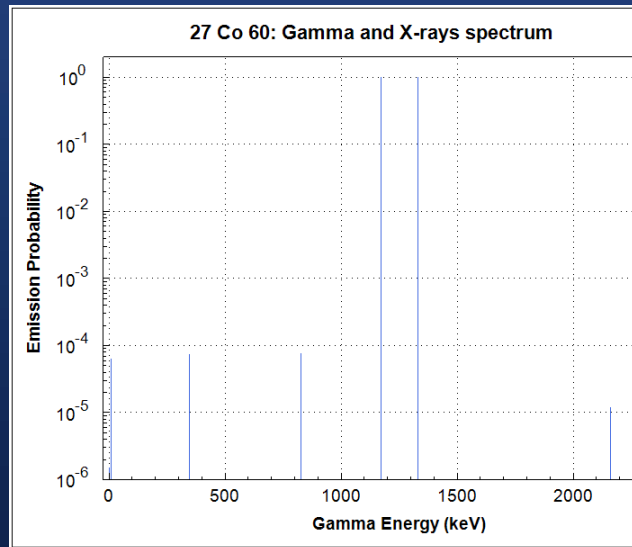
# Validated Nuclear Science Applications & Tools

## Decay Engine:



## Dosimetry & Shielding

The D&S module in Nucleonica allows the user to calculate gamma dose rates from point sources of single nuclides and nuclide mixtures. The user interface is shown in figure.



Gamma Energy (keV)	Emission Probability P (per disintegration)	Mass Attenuation Coeffi (shielding)(cm <sup>2</sup> /g)
1332.49	1.00E+00	0.00E+00
1173.23	9.99E-01	0.00E+00
826.1	7.60E-05	0.00E+00
347.14	7.50E-05	0.00E+00
2158.57	1.20E-05	0.00E+00
2505.69	2.00E-08	0.00E+00
7.47815	6.44E-05	0.00E+00
7.46089	3.27E-05	0.00E+00
8.26	1.31E-05	0.00E+00
0.85	1.49E-06	0.00E+00

Page: 1 / 1

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**Dosimetry and Shielding**  
**27 Cobalt**

Current Chart: Karlsruhe

Element: Co Mass: 60

☐ Include daughters

Dosimetry and Shielding Dose rate/Thickness graph Options Mixture details

**Initial source strength** Activity(Bq) 1.0000e+6

**Shielding material** Pb 0 cm

**Dose rate (μSv/h)** 3.37E-01

Source Shield Detector

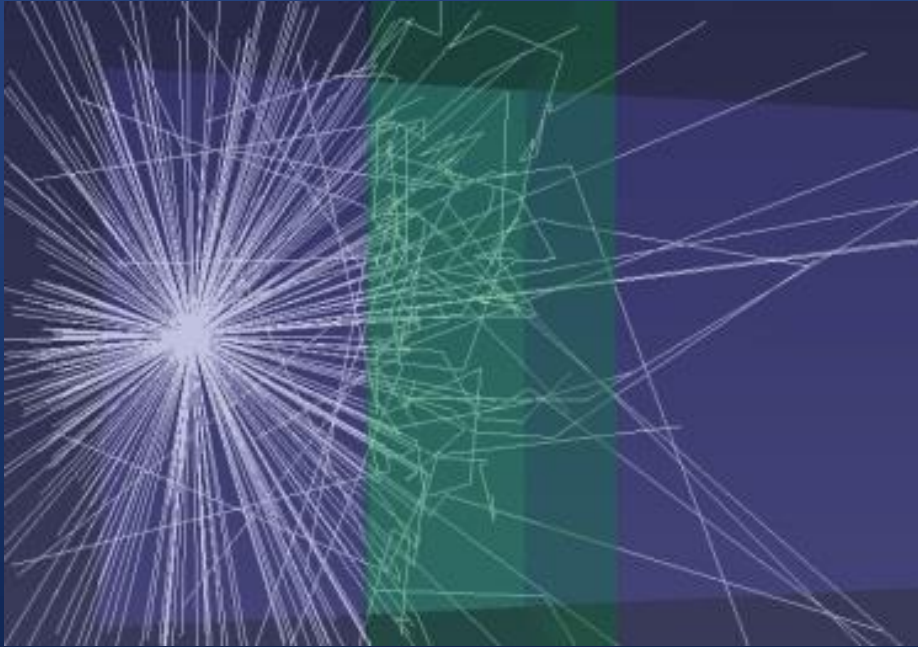
Source/detector distance (cm) 100

Start Reset

0.00E+00	1.00E+00	2.40E-02	5.51E-09	5.36E-09
0.00E+00	1.00E+00	1.22E+01	0.00E+00	0.00E+00
0.00E+00	1.00E+00	1.23E+01	0.00E+00	0.00E+00
0.00E+00	1.00E+00	9.01E+00	0.00E+00	0.00E+00
0.00E+00	1.00E+00	5.38E+03	0.00E+00	0.00E+00
			3.37e-1	3.13e-1

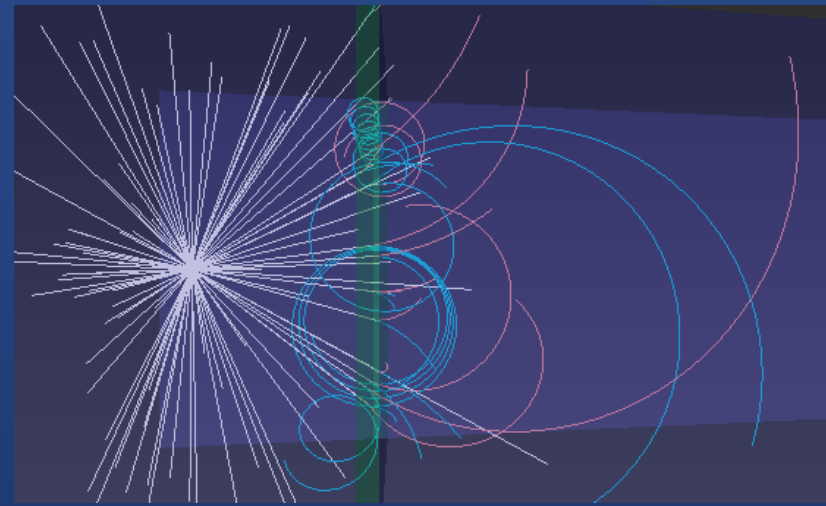


## Virtual Cloud Chamber

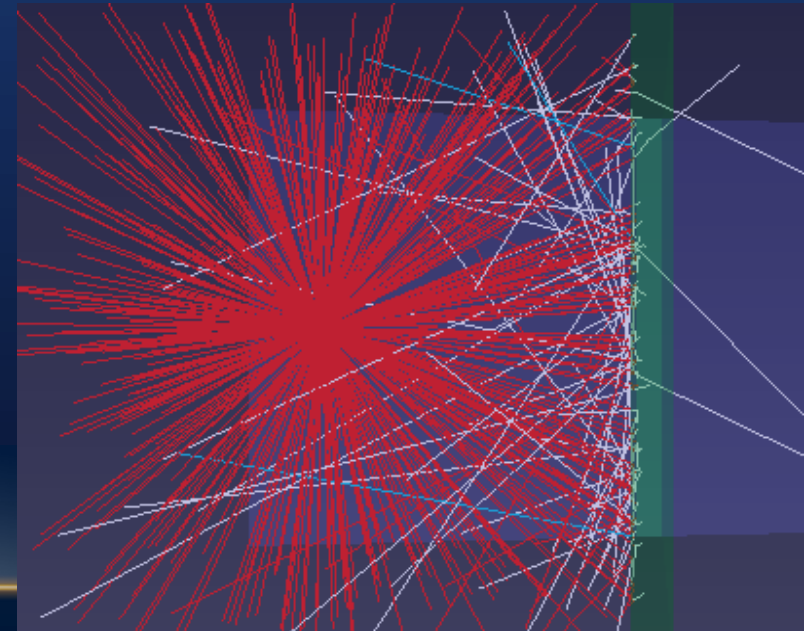


low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation

The red particles (3 MeV positrons) are blocked by a lead shield (green). When the positrons collide with the shield, they combine with electrons (blue) to create gamma radiation (white). Only a few gamma photons pass through the shield material.

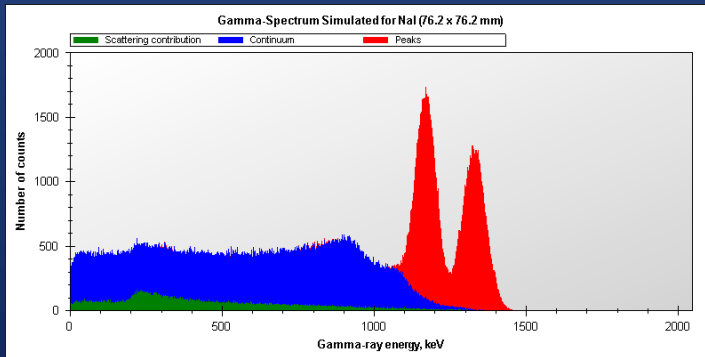


Electron-positron pairs are created using 10 MeV photons on lead. By “switching off” energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field.

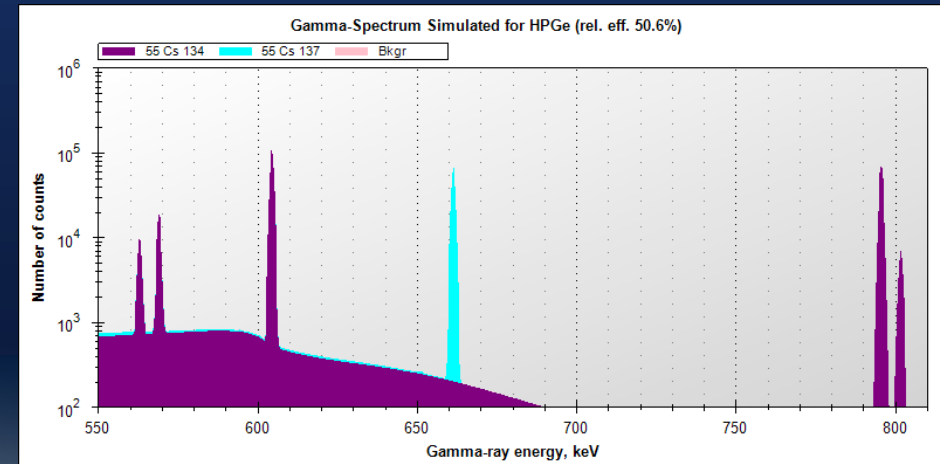
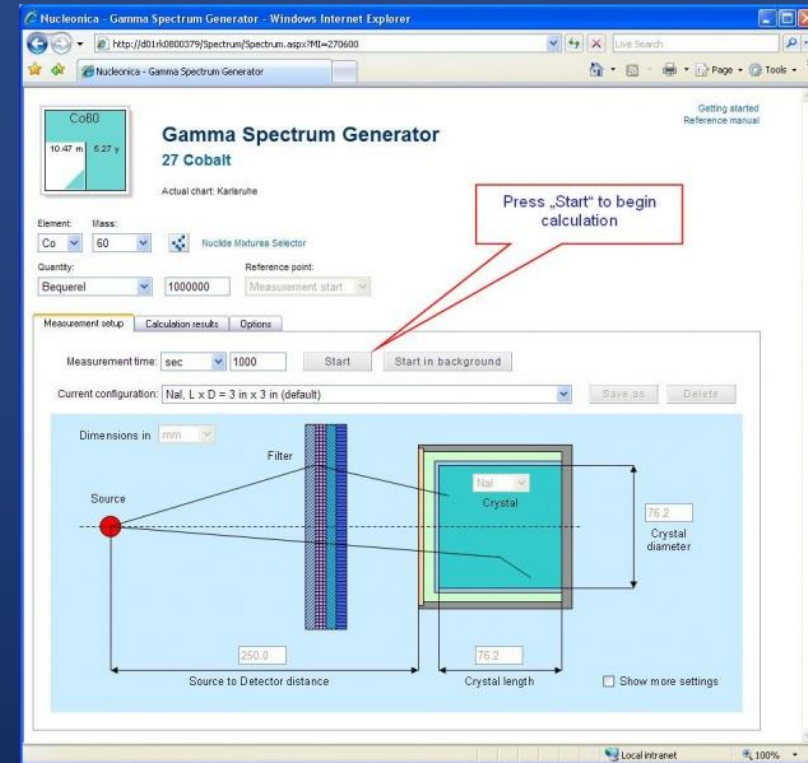
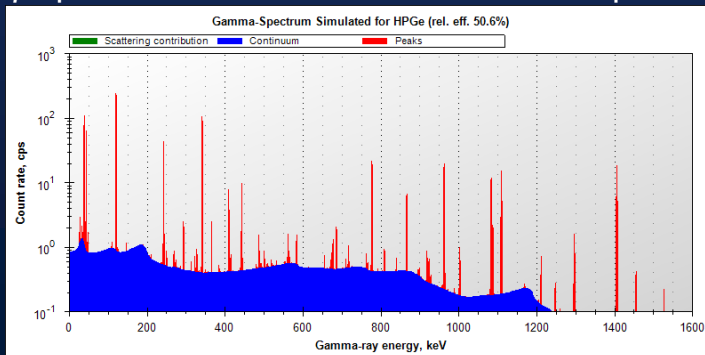


## Gamma Spectrum Generator

$\gamma$ -spectrum simulated for  $^{60}\text{Co}$  100 kBq source and NaI (3"  $\times$  3") detector:



$\gamma$ -spectrum simulated for  $^{152}\text{Eu}$  100 kBq source and HPGe detector.



Fukushima: Gamma spectrum of contamination at the Daiichi plant.  
Contamination is almost entirely to cesium-137 and cesium -134

# Validated Nuclear Science Applications & Tools

## webKORIGEN



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Version: 2012.08.09 17:55:51



### webKORIGEN

Questions, remarks, suggestions can be posted in the [forum](#)

webKORIGEN was developed from the Oak Ridge Isotope Generation and Depletion code ORIGEN. Starting with a given initial reactor fuel or a single target nuclide, it calculates the time evolution of nuclide densities changing due to decays and neutron-induced reactions, and determines derived nuclear properties such as masses, radioactivities, heat releases, radiotoxicities, emission of radiation, etc...



### webKORIGEN

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webKORIGEN was developed from the Oak Ridge Isotope Generation and Depletion code ORIGEN. Starting with a given initial reactor fuel or a single target nuclide, it calculates the time evolution of nuclide densities changing due to decays and neutron-induced reactions, and determines derived nuclear properties such as masses, radioactivities, heat releases, radiotoxicities, emission of radiation, etc...

Step 1: Calculation Mode

Step 2: Reactor / Operation

Step 3: Input Summary and Run

Step 4: Display Results

Step 5: Log files

Step 6: Parameters

### Display results for nuclides/elements dominant at 6 y decay

Nuclides/Elements Radiations Nuclide Chart

Display quantity: Mass (g)

Filter:

Save as Mixture ...of up to 20 selected Nuclides

Plot	Z	Nuclides	Results	Plot	Z	Elements	Results	Plots	Totals	Nuclides	Elements	Results
<input type="checkbox"/>	55	Cs133	3.416e+4	<input type="checkbox"/>	92	Uranium	1.861e+7	<input checked="" type="checkbox"/>	<b>Actinides+Progenies:</b>	<b>97</b>	<b>19</b>	<b>1.887e+7</b>
<input checked="" type="checkbox"/>	55	Cs137	3.410e+4	<input type="checkbox"/>	94	Plutonium	2.276e+5	<input type="checkbox"/>	Actinides:	61	11	1.887e+7
<input type="checkbox"/>	55	Cs135	1.208e+4	<input type="checkbox"/>	54	Xenon	1.699e+5	<input type="checkbox"/>	Transuranium:	38	7	2.610e+5
<input checked="" type="checkbox"/>	55	Cs134	6.419e+2	<input type="checkbox"/>	60	Neodymium	1.252e+5	<input type="checkbox"/>	Minor Actinides:	21	3	3.341e+4
<input type="checkbox"/>	55	Cs136	5.206e-9	<input type="checkbox"/>	40	Zirconium	1.150e+5	<input type="checkbox"/>	Radon:	3	1	1.417e-9
<input type="checkbox"/>	55	Cs138	4.691e-10	<input type="checkbox"/>	42	Molybdenum	1.084e+5	<input checked="" type="checkbox"/>	<b>Fission Products:</b>	<b>725</b>	<b>44</b>	<b>1.096e+6</b>
<input type="checkbox"/>	55	Cs139	1.107e-10	<input checked="" type="checkbox"/>	55	Cesium	8.098e+4	<input type="checkbox"/>	Lanthanides:	138	12	3.174e+5
<input type="checkbox"/>	55	Cs140	9.061e-12	<input type="checkbox"/>	58	Cerium	7.809e+4	<input type="checkbox"/>	Rare Earths:	180	14	3.445e+5
<input type="checkbox"/>	55	Cs138m	6.910e-12	<input type="checkbox"/>	44	Ruthenium	7.039e+4	<input type="checkbox"/>	Noble Metals:	90	4	1.385e+5
<input type="checkbox"/>	55	Cs141	2.523e-12	<input type="checkbox"/>	56	Barium	5.764e+4	<input type="checkbox"/>	Inert Gases (Ne, Ar, Kr, Xe):	46	2	1.808e+5
<input type="checkbox"/>	55	Cs135m	1.396e-12	<input type="checkbox"/>	46	Palladium	5.336e+4	<input type="checkbox"/>	Hydrogen:	3	1	1.275e+0
<input type="checkbox"/>	55	Cs134m	1.228e-13	<input type="checkbox"/>	57	Lanthanum	3.918e+4	<input type="checkbox"/>	<b>Helium:</b>	<b>1</b>	<b>1</b>	<b>9.335e+1</b>
<input type="checkbox"/>	55	Cs142	5.938e-14	<input type="checkbox"/>	59	Praseodymium	3.635e+4	<input type="checkbox"/>	<b>Total:</b>	<b>823</b>	<b>64</b>	<b>1.997e+7</b>
<input type="checkbox"/>	55	Cs143	1.592e-14	<input type="checkbox"/>	62	Samarium	2.612e+4					
<input type="checkbox"/>	55	Cs144	1.650e-15	<input type="checkbox"/>	43	Technetium	2.462e+4					
<input type="checkbox"/>	55	Cs145	6.462e-17	<input type="checkbox"/>	38	Strontium	2.433e+4					
<input type="checkbox"/>	55	Cs146	2.443e-18	<input type="checkbox"/>	93	Neptunium	1.574e+4					
<input type="checkbox"/>	55	Cs147	6.569e-20	<input type="checkbox"/>	95	Americium	1.534e+4					
<input type="checkbox"/>	55	Cs148	9.250e-22	<input type="checkbox"/>	39	Yttrium	1.397e+4					

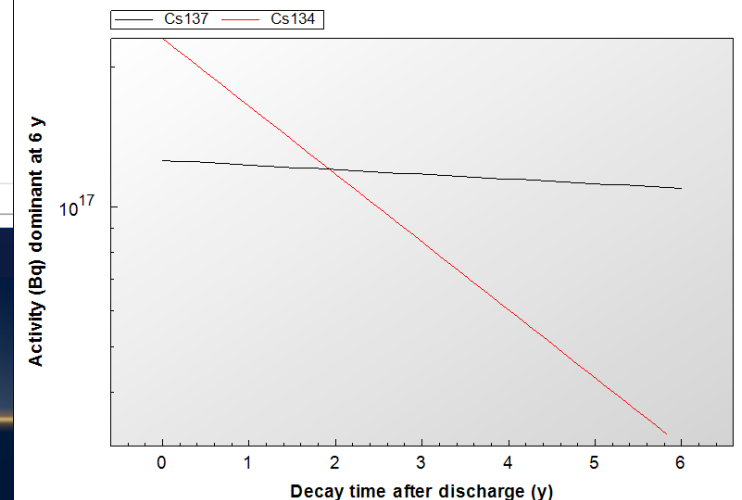
Reactor irradiation

Decay

Power  
Flux

Reactor irradiation and decay

### Nuclides during 6 y decay of 20 tHM PWR UOX 55 MWd/kg



# Validated Nuclear Science Applications & Tools

## e-Ship: package classification for radioactive transport

### Nuclear material transport report

Transport report generated for source: Pu-241 with daughters by magill on 8/14/2012 2:01:20 PM

**Source:** Pu-241 with daughters  
The sample - initially 15mg Pu-241. The sample is cooled for a period of 8 years and is solid, non-special form the daughters Am-241, Np-237, and Pa-233 Pu-241 - 15 mg, 8 years old - Solid, Non special form

**Form:** Material, Other form, Solid

**Matrix mass:** 1 g


#### Source characterisation

Nuclide	Mass (g)	Activity (Bq)	Heat (W)	Gamma dose rate H <sub>10</sub> (μSv/h) at 10 cm
Am-241	4.77e-3	6.05e+8	5.44e-4	1.15e+3
Np-237	3.20e-5	8.35e+2	6.59e-10	1.50e-3
Pa-233	1.06e-12	8.15e+2	5.38e-11	3.34e-3
Pu-241	1.02e-2	3.90e+10	3.34e-5	3.90e+3
<b>Total:4</b>	<b>1.50e-2</b>	<b>3.96e+10</b>	<b>5.78e-4</b>	<b>5.05e+3</b>

#### Package characterisation


Nuclide	Activity (Bq)	Exempt (Bq)	Excepted (GBq)	A <sub>2</sub> (TBq)	A / Exempt	A / Excepted	A / A <sub>2</sub>
Am-241	6.05e+8	1.00e+4	1.00e-3	1.00e-3	6.05e+4	6.05e+2	6.05e-1
Np-237	8.35e+2	1.00e+3	2.00e-3	2.00e-3	8.35e-1	4.18e-4	4.18e-7
Pa-233	8.15e+2	1.00e+7	7.00e-1	7.00e-1	8.15e-5	1.16e-6	1.16e-9
Pu-241	3.90e+10	1.00e+5	6.00e-2	6.00e-2	3.90e+5	6.50e+2	6.50e-1
<b>Total:4</b>	<b>3.96e+10</b>				<b>4.51e+5</b>	<b>1.26e+3</b>	<b>1.26e+0</b>

Type B Package



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ApplicationsDataKnowledgeMy PreferencesPrintNetworkingNuclear ScienceHelpNew Browser




**e-Ship**  
radiological transport service

My PackagesEditOptionsImportActivity limitsCERN fileSample packagesAbout e-Ship

User defined transport packages

ID	Package Name	Matrix mass (g)	Source	Form	State	Modified	Delete
(Create, import a new package)							
6	Electronic irradiated protons	1	Material	Other	Solid	2012.07.26 15:03:36	
5	Manual	1	Material	Other	Solid	2012.07.24 14:01:11	
4	Proton irradiated iron	1	Material	Other	Solid	2012.07.24 13:41:05	
38	Pu-241	15	Article	Other	Solid	2012.08.14 09:34:45	
11	Pu-241 with daughters	1	Material	Other	Solid	2012.08.10 09:05:09	
18	test	1	Material	Other	Solid	2012.07.26 15:22:04	
27	test GDR	1	Material	Other	Solid	2012.08.02 10:50:25	
37	testCo	1	Material	Other	Solid	2012.08.08 13:07:58	
19	U-233	1	Material	Other	Solid	2012.07.25 14:40:51	



**e-Ship**  
radiological transport service

Questions, remarks, suggestions can be posted in the forum

My PackagesEditOptionsImportActivity limitsCERN fileSample packagesAbout e-Ship

Name (ID=11)  
Pu-241 with daughters

Description:  
The sample - initially 15mg Pu-241.  
The sample is cooled for a period of 8 years and is solid, non-special form.  
It now contains the daughters Am-241, Np-237, and Pa-233  
Pu-241

Excepted Packages

Source

- Material
- Instruments / Articles

Form

- Other
- Special

State

- Solid
- Liquid
- Gas

Matrix mass: 1 g

Nuclide	Activity A (Bq)	Mass (g)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Excepted (GBq)	Exempt (Bq)	A / A <sub>2</sub>	A / Excepted	A / Exempt	Gamma dose rate H <sub>10</sub> (μSv/h) @ 10 cm	Delete
Am-241	6.05E+08	4.77e-3	10	0.001	1.00e-3	10000	0.605	605	6.05e+4	1.15e+3	
Np-237	8.35E+02	3.20e-5	20	0.002	2.00e-3	1000	4.18e-7	4.18e-4	0.835	1.50e-3	
Pa-233	8.15E+02	1.06e-12	5	0.7	0.700	1.00E+07	1.16e-9	1.16e-6	8.15e-5	3.34e-3	
Pu-241	3.90E+10	1.02e-2	40	0.06	6.00e-2	1.00E+05	0.650	650	3.90e+5	3.90e+3	
4	3.961e+10	1.500e-2					1.26	1.26e+3	4.51e+5		

Nuclide  
Pu-241

Quantity  
3.90E+10

Unit  
Bequerel

Update

Save PackageResetCancelReportSave as Sample

nucleonica

# Post-graduate research using Nucleonica

Nucleonica is currently being used by students for post-graduate research e.g.:

- Ph.D study of nuclear fuel cycles: The main goal is compare the amount of HLW which is stored and/or disposed for different fuel cycles, normalized to the same energy production.
- MPhil studies on modelling of atmospheric dispersion of radionuclide release from a research reactor. The aim is to compute: a) activity inventories of important radionuclides in the reactor core; b) release fractions; and c) activity released (to the atmosphere).
- Ph.D. studies medical physics: simulation of a HPGe detector used in the laboratory using the Gamma Spectrum Generator application.
- Ph.D. studies on Monte Carlo dosimetry calculations. Development of a general dosimetry and shielding application based on the CERN code GEANT4.
- MPhil studies on performance assessment of a borehole disposal facility for sealed radioactive sources. Various Nucleonica tools will be used for decay calculations, heat generation, gamma emission, neutron emission, external and internal radiotoxicities, etc.

Many of the technical problems arising in the course of these studies have been discussed on the Nucleonica Forum. Finally, we hope to be able to host the final reports from these studies on the Nucleonica web portal.



# Education & Training with Nucleonica

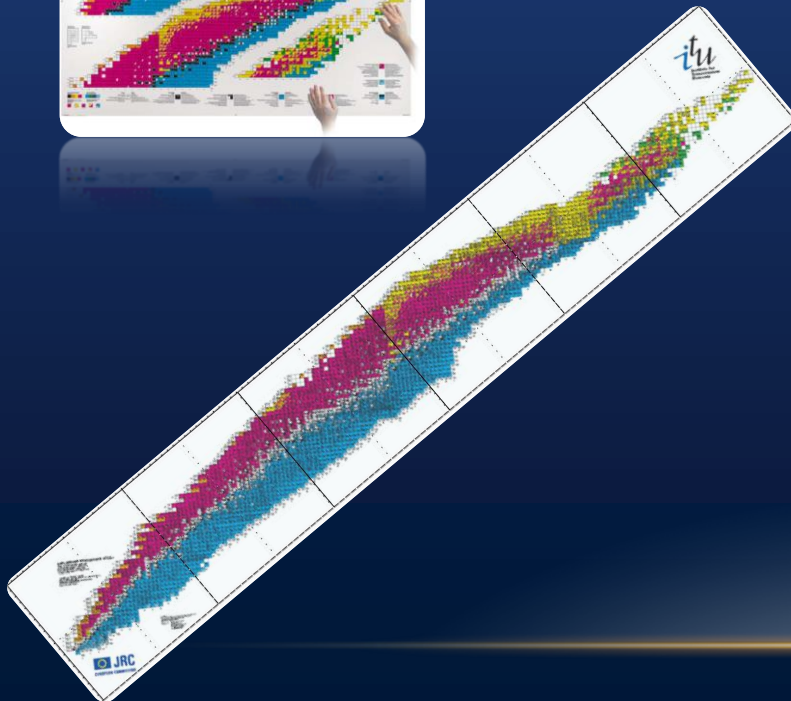
## Nucleonica for Smartphones: and Tablet PCs: M-Learning



# Karlsruhe Nuclide Chart



- Fold-out Chart
- Wall-Chart
- Auditorium Chart
- Nuclide Carpet

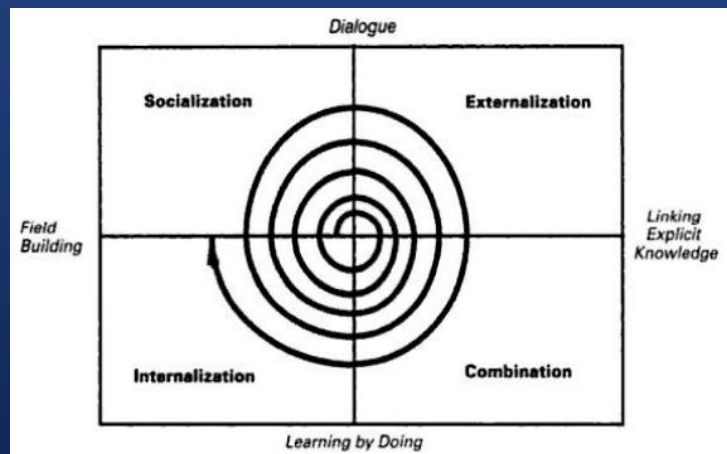


Nuclide „carpet“  
1m x 6.5m

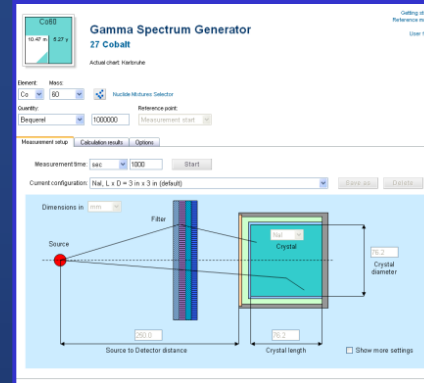


# Knowledge Management with Nucleonica

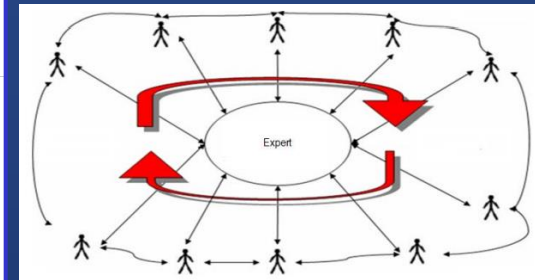
In this slide, the Nucleonica web portal is considered from a knowledge management perspective. Nonaka and Takeuchi have proposed the “knowledge spiral” (shown) in which there are four modes of knowledge conversion: socialization, externalization, combination and internalization (SECI model).



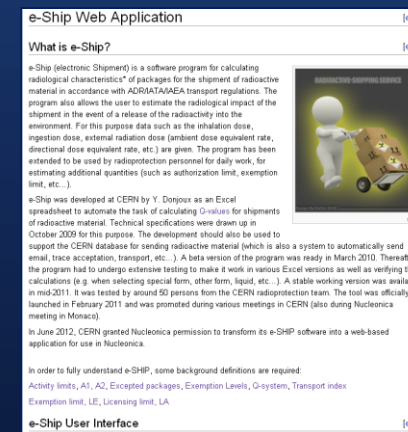
**Socialisation:** conversion of tacit knowledge to tacit knowledge e.g. an apprentice who works with tutor and learns from observing and imitating the tutor's actions. **Externalization:** conversion of tacit to explicit knowledge. **Combination** is the conversion of explicit to explicit knowledge. The process of systemizing already explicit knowledge into a knowledge system. **Internalization** is the conversion from explicit to tacit, which is closely related to “learning by doing”. At the end of the spiral process, one or more individuals in the organisation have acquired new tacit knowledge.



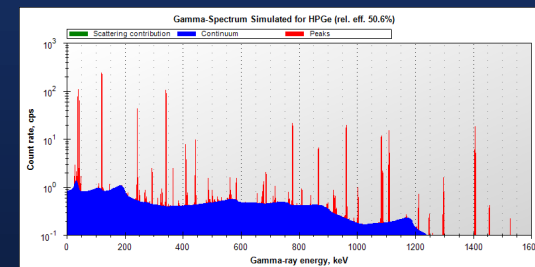
**Socialisation:** conversion of tacit knowledge to tacit knowledge



**Externalization:** conversion of tacit to explicit knowledge



**Combination:** systemizing explicit knowledge



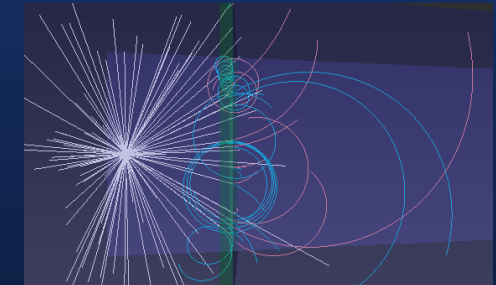
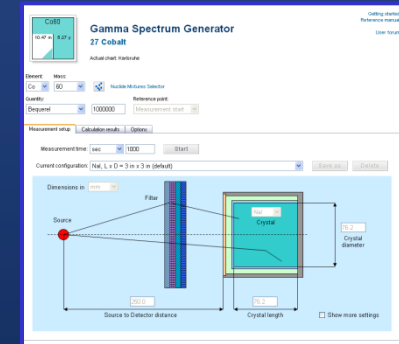
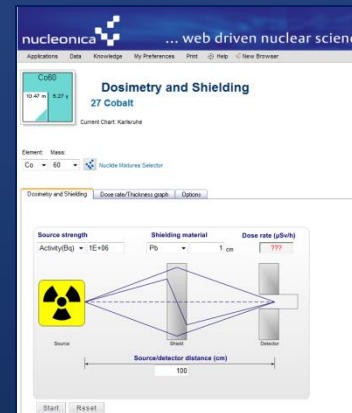
**Internalization:** conversion from explicit to tacit, triggered through “Learning by Doing”.




# Nucleonica: Web-based Software Tools for Simulation and Analysis



- Nuclear Data Resources in Nucleonica
- Nuclear Science Applications & Tools
  - Decay Engine
  - Dosimetry & Shielding
  - Virtual Cloud Chamber
  - Gamma Spectrum Generator
  - webKORIGEN
  - e-Ship
- Education & Training with Nucleonica
  - Post Grad. Research
  - Nucleonica Mobile
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica



# What you see when you login: Networking page - Wiki, Blog, Forum, ...



## ... web driven nuclear science

ApplicationsDataKnowledgeMy PreferencesPrintNetworkingNuclear ScienceHelpNew Browser

### > Nucleonica Networking

- >> Networking
- >> My Profile
- >> My Community
- >> My Mailbox
- >> My Groups
- >> My Settings

### > Tools


- >> Forum
- >> Conference Calendar
- >> webGraph
- >> Marketplace

### > Applications Portal

- >> nuclear science

### > Coming soon

- >> Virtual Cloud Chamber




#### >> New! Karlsruhe Nuclide "Carpet" – Floor Chart

January 07, 2012


The first product now available is the Karlsruhe Nuclide Chart as a Nuclide Carpet with dimensions 100 cm x 650 cm. This special Floor Chart is a tremendous eye catcher and has been developed specifically for exhibitions, reception and communal areas in your organization, libraries, etc.

#### >> Nucleonica Blog




##### New Nucleonica application released: Mass Activity Converter

This new application – the Mass Activity Converter – is a completely redesigned version of the Mass Activity Calculator. The main tab now shows the physical quantities expressed explicitly as a number multiplied by a unit (see figure). Another new feature is that the user can now choose between SI units (Bq, Gy, Sv) [...]




##### Nucleonica welcomes CERN users

Through an institutional license agreement, staff at the CERN has now full Premium access to the Nucleonica applications and features. CERN, the European Organization for Nuclear Research, is one of the world's largest and most respected centres for scientific research. Its business is fundamental physics, finding out what the Universe is made of and [...]



##### Nucleonica welcomes TRIUMF (Canada) Users

Through an institutional license agreement, staff at the TRIUMF – Canada's national laboratory for particle and nuclear physics – has now full Premium access to the Nucleonica applications and features. TRIUMF is one of the world's leading subatomic physics laboratories. It brings together dedicated physicists and interdisciplinary talent, sophisticated technical resources, and commercial partners. The [...]



##### New look Mass Activity Calculator

We have just released a new version of the Mass Activity Calculator. Apart from cosmetic changes, two new tabs have been introduced: Options and Mixture details. In the Options tab the user can specify the distance from the source in the calculation of the gamma dose rate (default value is 100 cm). In the Mixture [...]

#### Welcome, Joseph



My Settings



My ProfileMy Community

#### > My Community Events


- You have 0 new messages
- You have 0 new contact list requests

#### > Recent Nucleonica Members

Jeremie MuswemaDorry Crager


Mohd Irwan EffendiJamie Townes

#### >> Nucleonica Forum



##### Emergency preparedness analysis for decision-making

Given these 2 possible scenarios:  
1/ all releases are assumed to occur at a given stack height of more or less 50 m. The radionuclides released from...



##### Core Inventory calculations

My target is a HEU Low Power Tank-in-pool closed core Reactor (MNSR), 30 kW thermal power, with neutron flux of  $1.2 \times 10^{12} \text{ s}^{-1} \cdot \text{cm}^{-2}$ . Cooling system...



# What you see when you login – Nuclear science page

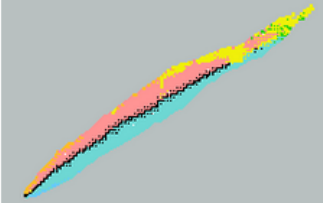
Logged in as: magill (Administrator) [Search](#) [Forum](#) [Calculator](#) [Privacy](#) [Legal](#)

nucleonica

... web driven nuclear science

Applications Data Knowledge My Preferences [Networking](#) [Nuclear Science](#) [Help](#) [New Browser](#) [Logout](#)

> Nuclide Explorer



» Actual Chart: Karlsruhe

> Search Nucleonica Documentation

Nuclide Search / Radiation Search

nucleonica

[wiki]

> Application Centre

» Mass Activity Calculator

» **New:** Mass Activity Converter

» Decay Engine

» **New:** Decay Engine++

» Dosimetry & Shielding

» Range & Stopping Power

» In Silico Dosimetry

» webKORIGEN

» Decay Engine for Large Nuclide Sets

» Universal Nuclide Chart

» Transport & Packaging

» **New:** e-Ship: radiological transport assistant

» Nuclide mixtures

» Nucleonica Scripting

» Radiological Dispersion Module

» Gamma Spectrum Generator

» Gamma Spectrum Generator Pro

» Virtual Cloud Chamber

» Geant4 Dosimetry

» easy Monte Carlo

» Cambio file Converter

» WESPA

» **New:** WESPA2

» Gamma Library

» webGraph

> Data Centre

» Physical Constants

» Nuclide Explorer

» Nuclide Datasheets++

» Nuclide Datasheets (Reference Data, Derived Data, Cross Sections, Radiations) (Prompt Gammas)

Welcome, Joseph

My SettingsAdministration

Networking

> My Last Nuclides

 35 Br84

 55 Cs137

 84 Po218

 84 Po210

 92 U238

> My Nuclide Mixtures

 Decay of 1.00e+6 Becquerel of 94 Pu 238 after 28.5806 Years(0)

 Natural Uranium

 Decay of 1e6 Becquerel of 92 U 235 after 7.04E+09 Years(0)

 Decay of 1.00e+6 Becquerel of 92 U 235 after 7.03814e+9 Years(0)

 Element Mg

> My Sources

 test cobalt

 testoo

 Pu241 with daughters

 Pu241- 15mg - 8y old - solid, non-special form

 Uranium metal

 Uranium.xml

 Pu239 1 g

> My Messages

No messages for you at the moment

> User Alerts

No alerts at the moment



**nucleonica** [wiki]

- navigation
  - Help
  - Glossary
  - Element Information
  - ReadingRoom
  - Gallery of Nuclear Science
  - Weblinks
  - Karlsruhe Nuclide Chart
  - Chat
  - Premium Membership
- support

---

[category](#) | 
 [discussion](#) | 
 [edit](#) | 
 [history](#) | 
 [delete](#) | 
 [watch](#)

## Category:Glossary


This Glossary is based mainly on the following sources:

1. J. Magill and J. Galy, [Radioactivity Radionuclides Radiation](#) & Springer Verlag, 2005
2. J. Magill, G. Pfennig, J. Galy, [Karlsruhe Nuclide Chart](#), 7th Edition, 2006.
3. Additional information can be found in the IAEA [Safety Glossary](#). Terminology Used in Nuclear Safety and Radiation Protection 2007 Edition.
4. See also the CTBTO glossary <http://www.ctbto.org/glossary/> &

### Articles in category "Glossary"

There are 179 articles in this category.

	<a href="#">page</a>	<a href="#">discussion</a>	<a href="#">view source</a>	<a href="#">history</a>	<a href="#">delete</a>	<a href="#">unwatch</a>
--	----------------------	----------------------------	-----------------------------	-------------------------	------------------------	-------------------------

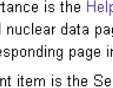
# Main Page

---

## Welcome to the Nucleonica Wiki

The Nucleonica wiki is an open knowledge resource for the nuclear sciences. In contrast to Wikipedia, which can be edited by anyone, the Nucleonica wiki articles are written by experts and practitioners in the field and cannot be edited. The Nucleonica wiki is devoted specifically to nuclear science. Wiki technology is best suited for this purpose since it allows addition of content at any time from any location.

Another aim the Nucleonica wiki is to provide the technical documentation in support of the Nucleonica nuclear science portal [www.nucleonica.com](http://www.nucleonica.com). Whereas the Nucleonica portal requires [registration](#) to access its applications and data pages, the wiki is an "open" knowledge resource.




---

## How this Wiki is organized

The Sidebar panel to the left of this window provides quick links to a number of important pages in this wiki. The links are grouped under:

- navigation
- support
- tools

The Wiki contains a collection of articles. Each article has a title (by which it is referenced) and optionally one or more categories. Under [Special / Categories](#) you can see all currently existing categories. Thus, it is possible to navigate through all documents by the category and subcategory tree feature of the Wiki.

Of special importance is the [Help](#) link. This page contains a collection of articles and is used specifically to support the Nucleonica applications and nuclear data pages. For users logged into the Nucleonica Portal, the context sensitive Help in Nucleonica will lead the user to the corresponding page in the wiki.

Another important item is the Search box. By entering a character string here, the entire wiki is searched. The search results are structured in a coherent way. Enter a piece of text into the Search box (e.g. Curie) and try out this powerful search tool!

---

## What is Nucleonica?

New! Nucleonica Newsletter

	<b>E cont.</b>		<b>O</b>
	▪ Exemption Levels		▪ Orphan source
	<b>F</b>		<b>P</b>
ed Dose	▪ Fermion		▪ Pair production
e(s)	▪ Find		▪ Parity
	▪ Fissile		▪ Particle Therapy
Exposure	▪ Fission		▪ Photon
Decay	▪ Fundamental forces		▪ Physical protection
Particle			▪ Polonium 210
Limit of Intake (ALI)			▪ Positron
Filter	<b>G</b>		▪ Primordial radionuclides
	▪ Gamma radiation		▪ Proton
	▪ Geological repository		
	▪ Glioblastoma		<b>Q</b>
	▪ Gram atom		▪ Quality factor
Weight	▪ Gray, (Gy)		
mass			<b>R</b>
number	<b>H</b>		▪ RCM
effect	▪ HASS Directive		▪ RDD
	▪ Hadron		
(Boron Neutron Capture Therapy)			

**nucleonica** [wiki]

readingroom | discussion | edit

# ReadingRoom:Gallery

Navigation  
 • Help  
 • Glossary  
 • Element Information  
 • ReadingRoom  
**• Gallery of Nuclear Science**  
 • Weblinks  
 • Karlsruhe Nuclide Chart  
 • Premium Membership

support  
 • Training Courses  
 • Nucleonica at a glance  
 • Nucleonica Overview  
 • Ask-an Expert  
 • FAQs  
 • Technical Support

tools  
 • Recent changes  
 • Random page  
 • Editing

search





toolbox  
 • What links here  
 • Related changes  
 • Upload file  
 • Special pages  
 • Printable version  
 • Permanent link





Contents page

- Actinide Science
- Nuclear Science Historical
- Nuclear Science in Karlsruhe...
- Karlsruhe Nuclide Chart, 7th Edition, 2009
- Radioactivity, Radionuclides, Radiations...

## Actinide Science

from the INS

			
Sample of refined americium metal condensed on a tantalum disc (Spiert, 1991), copyright EC-JRC-ITU	Curium metal produced by the Actinide Group, Institute for Transuranium Elements	Protactinium: Courtesy of the Actinide Group	Uranium metal cube, Institute for Transuranium Elements

			
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The Wiki contains Under [Special:](#) category and subcategory.

Of special importance are applications and user to the community.

Another important feature is structured in a database.

What is Nucleonica?

New! Nucleonica

[help](#) | 
 [discussion](#) | 
 [edit](#) | 
 [history](#) | 
 [delete](#) | 
 [move](#) | 
 [watch](#)

# Help:Decay Engine

Create [html file](#) for this document

---

**Contents** [hide]

- 1 Overview**
  - 1.1 Simple Radioactive Decay
  - 1.2 Radioactive Decay Chains
  - 1.3 Convergent and Divergent Branches
  - 1.4 Radioactive Equilibrium
    - 1.4.1 ( $t_1 \gg t_2$ ) : Secular Equilibrium:
    - 1.4.2 ( $t_1 \approx t_2$ ) : Transient Equilibrium
    - 1.4.3 ( $t_1 < t_2$ ): The Half-life of the Parent is Shorter than that of the Daughter
    - 1.4.4 ( $t_1 \approx t_2$ ): The Half-lives of the Parent and Daughter are Similar
- 2 Using the Decay Engine Module**
  - 2.1 User Interface
  - 2.2 Options
  - 2.3 Graph
  - 2.4 Details
- 3 References**

## Overview

### Simple Radioactive Decay

Radioactive decay is a random process. It is not possible to predict when a particular nucleus will decay, however, evaluate the probability that a nucleus will decay in a time interval. This was first identified by Rutherford, as

$$\frac{dQ}{dt} = -kQ$$

## Start of the Name Approval Process for the Elements of Atomic Number 114 and 116

February 19th, 2012

by Joseph Magill

A joint IUPAC/IUPAP Working Party (JWP) has confirmed the discovery of the elements with atomic numbers 114 and 116. In accord with IUPAC procedures, the discoverers proposed names as follows: flerovium and symbol, Fl, for the element with  $Z = 114$  and livermorium with the symbol Lv for the element with  $Z = 116$ . The Inorganic Chemistry Division recommended these proposals for acceptance.

Comments should be submitted by 30 April 2012. The text of the Provisional Recommendation can be downloaded from


[http://media.iupac.org/reports/provisional/abstract11/corish\\_300412.html](http://media.iupac.org/reports/provisional/abstract11/corish_300412.html).

Comments should be sent to Prof. John Corish at [jcorish@tcd.ie](mailto:jcorish@tcd.ie).

116				Lv	Lv 290 7.1 ms $\alpha$ 10.84	Lv 291 18 ms $\alpha$ 10.74	Lv 292 18 ms $\alpha$ 10.66	Lv 293 53 ms $\alpha$ 10.63
115		Uup	Uup 287 32 ms $\alpha$ 10.69	Uup 288 87 ms $\alpha$ 10.46	Uup 289 0.22 s $\alpha$ 10.31	Uup 290 ~16 ms $\alpha$ 9.96	176	
114	Fl	Fl 285 ~125 ms $\alpha$	Fl 286 0.13 s $\beta^-$ $\alpha$ 10.19	Fl 287 0.48 s $\alpha$ 10.02	Fl 288 0.69 s $\alpha$ 9.96	Fl 289 2.1 s $\alpha$ 9.87		

Extract from the new 8th Edition (2012) of the Karlsruhe Nuclide Chart showing the isotopes of flerovium and livermorium.

# The Nucleonica Forum...



☐ Remember Me?

[Help](#)
[Register](#)

Advanced Search











[Forum](#)
[Nucleonica Portal](#)
[General](#)

If this is your first visit, be sure to check out the [FAQ](#) by clicking the link above. You may have to [register](#) before you can post: click the register link above to proceed. To start viewing messages, select the forum that you want to visit from the selection below.

Threads 1 to 20 of 105

Page 1 of 6
 [1](#)
[2](#)
[3](#)
[...](#)
[Last](#)

**Forum: General**  
 General comments

Title / Thread Starter	Replies / Views	Last Post By
 <a href="#">Emergency preparedness analysis for decision-making</a> Jeremie Muswema	Replies: 0 Views: 21	Jeremie Muswema 13-04-12 13:02
 <a href="#">Core Inventory calculations</a> Jeremie Muswema	Replies: 1 Views: 20	HotCells 12-04-12 18:34
 <a href="#">Functionality of the "Gamma Library"</a> Niko	Replies: 4 Views: 80	Jeremie Muswema 12-04-12 17:52
 <a href="#">Being notified for a new thread in the forum</a> SpectrO	Replies: 4 Views: 314	SpectrO 15-03-12 10:59
 <a href="#">Reference book or paper about cross section for neutron induced reactions</a> Giancarlo D'Agostino	Replies: 1 Views: 227	jmagill 09-02-12 07:44
 <a href="#">Free users and WESPA</a> jivko	Replies: 1 Views: 243	jmagill 30-01-12 14:49
 <a href="#">NuTRoNS-2 Monte Carlo, Monaco</a> jmagill <a href="#">1</a> <a href="#">2</a>	Replies: 10 Views: 2,047	zeynepyarar 17-11-11 22:09
 <a href="#">Fission products from spontaneous fission</a> FAQ	Replies: 1 Views: 246	FAQ 09-11-11 07:17
 <a href="#">webKORIGEN output in EXCEL format</a> XRay	Replies: 1 Views: 599	HotCells 26-09-11 18:26
 <a href="#">Why does HEU produce fewer counts than pure U235 in the Gamma Spectrum Generator?</a> XRay	Replies: 1 Views: 464	HotCells 22-09-11 12:02

# Training courses...





# Thank You!